Pulsed XeCl Excimer Laser Annealing of Silicon Film

February, 1991

Toshiyuki SAMESHIMA

30ns–Pulsed XeCl (308nm) excimer laser annealing of hydrogenated amorphous silicon (a–Si:H) film was studied in order to fabricate polycrystalline silicon thin film transistors (poly–Si TFTs) at a low temperature. Poly–Si film with a small grain (<100 nm) was formed through rapid laser–induced melting (<100 ns) of a–Si:H film without heating a glass substrate. Reversible phase transition from crystalline to amorphous state was also observed. The transition was controlled by the laser energy density. In addition, a laser doping technique was developed in order to form heavily doped ($\geq 10^{21} cm^{-3}$) source and drain regions in TFTs. Our laser doping method employed radio–frequency glow discharge to uniformly deposit a dopant film on silicon, followed by laser induced melting of silicon leading to diffusion of dopant atoms. Transient conductance measurements revealed that dopant atoms were activated immediately after molten silicon solidified. N–channel and p–channel poly–Si TFTs were fabricated at 250℃ using the techniques of laser–induced crystallization and laser doping. The carrier mobility was 54 cm^2/Vs for n–channel TFT and 20 cm^2/Vs for p–channel TFT, respectively. These values are as large as those for poly–Si TFTs fabricated at 1000℃ by a conventional process. Through this thesis, we demonstrated that pulsed XeCl excimer laser annealing process is suitable for fabricating poly–Si TFTs at a low temperature.